

EXHIBIT B10



Contract Work Authorization
Change Order

Contract Work Authorization (CWA) Change Order

This is Change Order ("CO") No. 01 to Contract Work Authorization No. C5455 dated February 16, 2018 issued under and pursuant to the Blanket Agreement or Master Service Agreement No. 4400006370 dated February 8, 2012 (the "MSA") between the below-named Contractor ("Contractor"), a Massachusetts company, and Pacific Gas and Electric Company ("PG&E"), a California corporation with its headquarters located at 77 Beale Street, San Francisco, California 94105. Contractor shall perform all Work under this CWA, as amended by this Change Order, pursuant to and in accordance with the terms and conditions of the MSA.

Contractor's
Legal Name: GEI Consultants, Inc.

This Change Order consists of 2 pages.

Contractor's
Address: 180 Grand Avenue, Suite 1410
Oakland, CA 94612

Project Name: 2018 DSOD Hi Hzd Inundation Map Updates and CAS Breach Analyses

Job Location: Various

CHANGES: The Parties hereby modify the Contract Work Authorization referenced above as follows:

GEI Consultants to provide the necessary labor for tasks to be performed for failure analysis and report preparation for eight (8) dams and four (4) spillways (CASs), and prepare inundation maps for thirty-three (33) dams and four (4) CASs required for the 2018 DSOD Hi Hazard Dam/Spillway Inundation Mapping Project.

GEI Consultants to proceed with Quarter 2, 3 and 4 work as determined by Project Engineer Andrew Fisher and as stated in the original contract scope of work.

Contractor shall provide PG&E approved subcontractor invoices, if any, to verify all costs associated with this Change Order.

This Change Order No. 1 represents full and final consideration for the changes described herein, including but not limited to all adjustments to price, schedule, guaranteed dates and performance criteria for work that was not included in the original Contract scope of work. All other work descriptions of the original Contract shall remain unchanged and in effect.


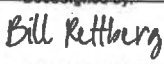
ATTACHMENTS: The following are attached to this CWA Change Order and incorporated herein by this reference.

Attachment No. N/A

PRICING CHANGES:	Previous Total CWA Value:	\$ 205,000.00
	Addition or Deduction:	\$ 667,300.00
	Revised Total CWA Value:	\$ 872,300.00

All other terms and conditions of the CWA, as it may have been amended by previous CWA Change Order(s), if any, shall remain the same.

THE PARTIES, BY SIGNATURE OF THEIR AUTHORIZED REPRESENTATIVES, HEREBY AGREE TO THE TERMS OF THIS CWA CHANGE ORDER.

PACIFIC GAS AND ELECTRIC COMPANY		CONTRACTOR: GEI CONSULTANTS	
Signature	 DocuSigned by: 8A7C41748F1D404...	Signature	 DocuSigned by: 11F0B202EC63404...
Name	Robin Kirkpatrick	Name	
Title	Supervisor, Sourcing Operations	Title	
Date	4/20/2018	Date	4/20/2018



Contract Work Authorization No. C5455
CWA Change Order No. 01
Page 2 of 2

ADMINISTRATION			
PG&E Negotiator	Holly Krieg	Contractor Representative	William Rettberg, P.E., Vice President
Phone	916-742-9543	Phone	510-350-2900
Email:	hxkn@pge.com	Email:	wrettberg@geiconsultants.com
Accounting Reference	8093568		

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Distribution Date		
Distribution of Copies:	<input type="checkbox"/> Document Services (Signed Original Copy) Mail Code N5D 245 MARKET ST., SAN FRANCISCO	<input type="checkbox"/> Contractor (Signed Original Copy)
	<input checked="" type="checkbox"/> Work Supervisor – Andrew Fisher- a1fi@pge.com PM : Dave Ritzman-dlrm@pge.com Ada Luyin Zhu-lxz3@pge.com	<input type="checkbox"/> Manager
	<input checked="" type="checkbox"/> Invoice Approver Johnny Chan-j9c1@pge.com	<input type="checkbox"/> Supervisor
	<input type="checkbox"/> V.P.	<input checked="" type="checkbox"/> Sourcing/ Purchasing Holly Krieg-hxkn@pge.com
	<input type="checkbox"/> Director	<input type="checkbox"/> Law

Table 2 - GEI Proposal Budget

[illegible]

GEI Consultants, Inc.
Proposal No. 1600180 Budget for 2018 Engineering Services;
2018 DBOD High Hazard Inundation Mapping
Pacific Gas and Electric Company

Rates based on Master Service Agreement No. 4400006370 between GEI and PG&E

FEE SCHEDULE AND PAYMENT TERMS**FEE SCHEDULE**

<u>Personnel Category</u>	<u>Hourly Billing Rate</u> <u>\$ per hour</u>
Staff Professional – Grade 1	\$ 105.47
Staff Professional – Grade 2	\$ 116.24
Project Professional – Grade 3	\$ 128.08
Project Professional – Grade 4	\$ 142.07
Senior Professional – Grade 5	\$ 158.98
Senior Professional – Grade 6	\$ 192.65
Senior Professional – Grade 7	\$ 228.17
Senior Consultant – Grade 8	\$ 256.15
Senior Consultant – Grade 9	\$ 315.35
Senior Principal – Grade 10	\$ 315.35

Senior CADD Drafter and Designer	\$ 131.30
CADD Drafter / Designer and Senior Technician	\$ 119.47
Technician, Word Processor, Administrative Staff	\$ 95.84
Office Aide	\$ 75.89

These rates are billed for both regular and overtime hours in all categories.

OTHER PROJECT COSTS

Subconsultants, Subcontractors and Other Project Expenses - All costs for subconsultants and subcontractors will be billed at cost plus a 7% service charge and all other ordinary project expenses will be billed at cost. Examples of such expenses ordinarily charged to projects are subconsultants: chemical laboratory charges; rented or leased field and laboratory equipment; outside printing and reproduction; communications and mailing charges; reproduction expenses; shipping costs for samples and equipment; disposal of samples; rental vehicles; fares for travel on public carriers; special fees for insurance certificates, permits, licenses, etc.; fees for restoration of paving or land due to field exploration, etc.; state sales and use taxes and state taxes on GEI fees.

Field and Laboratory Equipment Billing Rates – GEI-owned field and laboratory equipment such as pumps, sampling equipment, monitoring instrumentation, field density equipment, portable gas chromatographs, etc. will be billed at a daily, weekly, or monthly rate, as needed for the project. Expendable supplies are billed at a unit rate.

Transportation and Subsistence - Automobile expenses for GEI or employee owned cars will be charged at the rate per mile set by the Internal Revenue Service for tax purposes plus tolls and parking charges or at a day rate negotiated for each project. When required for a project, four-wheel drive vehicles owned by GEI or the employees will be billed at a daily rate appropriate for those vehicles. Per diem living costs for personnel on assignment away from their home office will be negotiated for each project.

Rates – Escalation on rates above shall not exceed 2.5% per contract year.



Contract Work Authorization

Contract Work Authorization (CWA)

This Contract Work Authorization ("CWA") No. C5455 is issued under and pursuant to the Blanket Agreement or Master Service Agreement No. 4400006370 dated February 8, 2012 (the "MSA") between the below-named Contractor ("Contractor"), a Massachusetts Company, and Pacific Gas and Electric Company ("PG&E"), a California corporation with its headquarters located at 77 Beale Street, San Francisco, California 94105. Contractor shall perform all Work under this CWA pursuant to and in accordance with the terms and conditions of the MSA.

Contractor's Legal Name: GEI Consultants, In.

Total Number of Pages: 12

Contractor's Address: 180 Grand Avenue, Suite 1410
Oakland, CA 94612

Project Name: 2018 DSOD Hi Hzd Inundation Map Updates and CAS Breach Analyses

Job Location: Various

WORK: Contractor shall, at its own risk and expense, perform the Work described in this Contract Work Authorization and furnish all labor, equipment, and materials necessary to complete the Work as summarized below and as more fully described in Attachment 1, Scope of Work.

GEI Consultants to provide the necessary labor for tasks to be performed for failure analysis and report preparation for eight (8) dams and four (4) spillways (CASs), and prepare inundation maps for thirty-three (33) dams and four (4) CASs required for the 2018 DSOD Hi Hazard Dam/Spillway Inundation Mapping Project.

GEI Consultants to proceed with Quarter 1 projects and Quarter 2 Inundation maps as directed by Project Engineer Andrew Fisher and as stated in the scope of work.

A contract change order will be issued for Quarter 2, 3 and 4 work as determined by Project Engineer Andrew Fisher.

ATTACHMENTS: Each of the following documents are attached to this CWA and are incorporated herein by this reference:

Attachment 1: Scope of Work, 6 Pages

Attachment 2: Table 1-2018 Inundation Mapping DSOD High Hazard, 1 Page

Attachment 3: Table 2-Proposal Budget, 2 Pages

Attachment 4: Fee Schedule and Payment Terms, 1 Page

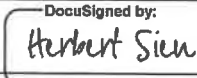

CWA TERM: This CWA is effective upon signature by both parties and expires on January 31, 2019. Time is of the essence.

CWA COMPLETION: Contractor shall commence performance hereof when directed to do so by PG&E and Work shall be completed by the completion date of January 31, 2019.

CONSIDERATION: As full consideration for satisfactory performance of the Work under this CWA by Contractor, PG&E's total obligation to Contractor shall not exceed the following amount. This amount is inclusive of all taxes incurred in the performance of the Work. Any change to this amount shall only be authorized in writing by a PG&E CWA Change Order, fully executed by both PG&E and Contractor.

TOTAL: \$205,000.00 (Two Hundred Five Thousand Dollars and No/100)

THE PARTIES, BY SIGNATURE OF THEIR AUTHORIZED REPRESENTATIVES, HEREBY AGREE TO THE TERMS OF THIS CONTRACT WORK AUTHORIZATION.

PACIFIC GAS AND ELECTRIC COMPANY		CONTRACTOR: GEI CONSULTANTS, IN.	
Signature	 DocuSigned by: Herbert Sien	Signature	 DocuSigned by: Bill Rethberg
Name	Robin Kirkpatrick BD1558365F264F0...	Name	11F9B292EC63401...
Title	Supervisor, Sourcing Operations	Title	
Date	2/16/2018	Date	2/16/2018

62-4229 CWA (9/26/11)

Sourcing



Contract Work Authorization

CWA No. C5455
Page 2 of 2

ADMINISTRATION			
PG&E Negotiator	Holly Krieg	Contractor Represent	
Phone	916-742-9543	Phone	
Email	hxkn@pge.com	Email	
Accounting Reference	8093568		
PG&E Work Supervisor:	Andrew Fisher-a1fi@pge.com	Phone:	415-973-4579
INVOICE INSTRUCTIONS: Contractor shall send invoices for each payment when due, showing the CWA number, to: PACIFIC GAS AND ELECTRIC COMPANY	Send ORIGINAL Invoice to: (See note below if using PG&E's electronic invoicing system)	PG&E Accounts Payable* PO Box 7760 San Francisco, CA 94120-7760	
	Send COPY of Invoice to:	Johnny Chan-j9c1@pge.com	
	For information regarding invoice status, call PG&E's Paid Help Line at (800) 756-PAID (7243) or go to AP Web Reporting site at www.pge.com/actpay . *Note: Contractors using PG&E's electronic invoicing system do not need to mail a copy of the invoice to PG&E Accounts Payable.		

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Distribution Date			
Distribution of Copies:	<input type="checkbox"/> Document Services (Signed Original Copy) Mail Code N5D 245 MARKET ST., SAN FRANCISCO	<input type="checkbox"/> Contractor (Signed Original Copy)	
	<input checked="" type="checkbox"/> Work Supervisor- Andrew Fisher- a1fi@pge.com Dave Ritzman-dlrm@pge.com Ada Luyin Zhu-lxz3@pge.com	<input type="checkbox"/> Manager	
	<input checked="" type="checkbox"/> Invoice Approver- Johnny Chan- j9c1@pge.com	<input type="checkbox"/> Supervisor	
	<input type="checkbox"/> V.P.	<input checked="" type="checkbox"/> Sourcing/ Purchasing-Holly Krieg-hxkn@pge.com	
	<input type="checkbox"/> Director	<input type="checkbox"/> Law	



Contract Change Order

This is Change Order ("CO") No. 4 to Contract No. C595 formerly 4400006370 dated 2/8/2012 between the below-named Contractor ("Contractor"), a California Corporation, and Pacific Gas and Electric Company ("PG&E"), a California corporation with its headquarters located at 77 Beale Street, San Francisco, California 94105. Contractor shall perform all Work under this Contract, as amended by this Change Order, pursuant to and in accordance with the terms and conditions of the Contract.

Contractor's
Legal Name: GEI Consultants, Inc.

This Contract Change Order consists of 2 page(s).

Contractor's
Address: 180 Grand Avenue, Suite 1410
Oakland, CA 94612

Project Name: FERC Part 12 (5) Year Review for Safety Reports for PG&E Dams Safety

Job Location: PG&E Service Area - locations mutually agreed between both parties

CHANGES: The Parties hereby modify the Contract referenced above as follows:

The Contract expiration date is hereby extended from March 30, 2018 to **June 30, 2018**.

- The Parties specifically agree that this Contract shall be deemed to have been in effect continuously and without interruption since the original effective date of February 8, 2012.

ATTACHMENTS: The following are attached to this Contract Change Order and incorporated herein by this reference.

Attachments: N/A

PRICING CHANGES:	Previous Total Contract Value:	This Agreement holds no value. All funding for efforts under this blanket Agreement Will be issued in the form of Contract Work Authorizations (CWA) under the Blanket Agreement number.
	Addition or Deduction:	
		~0~

All other terms and conditions of the Contract, as it may have been amended by previous Contract Change Order(s), if any, shall remain the same.

THE PARTIES, BY SIGNATURE OF THEIR AUTHORIZED REPRESENTATIVES, HEREBY AGREE TO THE TERMS OF THIS CONTRACT CHANGE ORDER.

PACIFIC GAS AND ELECTRIC COMPANY		CONTRACTOR: GEI CONSULTANTS, INC.	
Signature	e-Signed by Arzu Ozbek on 2018-04-03 23:52:08 GMT	Signature	
Name	Arzu Ozbek	Name	WILLIAM RETBERG
Title	Generation Portfolio Manager	Title	SEN. VP
Date	April 03, 2018	Date	4/2/18



Change Order No. 4
Contract No. C595 formerly 4400006370
Page 2 of 2

ADMINISTRATION			
PG&E Negotiator	April Titus	Contractor Representative	Rettberg, William
Phone	415-973-7882	Phone	(510) 910-2201 Cell
Email:	adta@pge.com	Email:	wrettberg@geiconsultants.com
Accounting Reference	Various by CWA		

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Distribution Date		
Distribution of Copies	<input checked="" type="checkbox"/> Document Services (Signed Original Copy) Mail Code N5D 245 MARKET ST., SAN FRANCISCO	<input checked="" type="checkbox"/> Contractor (Signed Original Copy)
	<input checked="" type="checkbox"/> Work Supervisor: Cathy Ly	<input type="checkbox"/> Manager
	<input type="checkbox"/> Invoice Approver	<input type="checkbox"/> Supervisor
	<input type="checkbox"/> V.P.	<input checked="" type="checkbox"/> Sourcing/ Purchasing: April D. Titus
	<input type="checkbox"/> Director	<input type="checkbox"/> Law

62-4675 (12-1-08)

Sourcing

Purchase Order Details

PO Number	2700070537	Customer	Ship To Address
Date	Feb 22, 2018	Pacific Gas & Electric Inc	245 MARKET STREET
Status	New	77 Beale Street	SAN FRANCISCO, CA 94105
PO Amount	\$205,000.00	San Francisco, CA 94177	US (United States)
Invoiced Amount	\$0.00	US (United States)	
Currency	USD (US Dollar)	PO Box 770000	
Buyer Contact	Ariba Purchasing G		
Customer Contact	Johnny Chan j9c1@pge.com 415-973-5302		
Payment Terms	30 days net		

Item Number	Description	Ordered Qty	Delivery Date	Invoiced Qty	Item Price	Unit of Measure
1	GEI 205k 2018 DSOD Hi Hzd Inundation Map	205,000	Feb 16, 2018	0	\$1.00	USD (US Dollar)

The Purchase Order data presented in this document does not necessarily contain all information and details that your customer shared with you. This representation reflects the PO data available in the Taulia platform. Typically, the PO data provided through Taulia can not entirely replace the PO information provided to you by your customer



Supply Chain Responsibility - List of Subcontractors and Disbursement Record
EXHIBIT 1-A

(See Instructions on Page 2)

Bidder's Company Name:		Name of Preparer:	
Employer Identification # (EIN)		Telephone : () -	
G&E Contract Number (if any):		E-Mail:	
PG&E Project/Product:		Is Bidder CPUC Clearinghouse Certified?	Yes No
Contract Duration (Year):		Is Bidder a Registered Small Business?	Yes No
Total Bid Value:	To:	From:	Small Business #

(1) Subcontractor Name	(2) CPUC Clearinghouse VON#	(3) Diverse Code	(4) Small Bus. # (DGS, SBA, etc.)	(5) Small Bus. Code	(6) Address (City, State, Zip)	(7A) Work Description	(7B) Risk Level (High, Med, Low)	(8) Estimated Amount to be Paid to Subs - CPUC Clearinghouse	(9) Estimated Amount to be Paid to Subs - Small Business
No subs									
The successful Bidder(s) will be expected to register and report all monthly subcontracted spend with subcontractors for the duration of the contract at: https://cvmas10.cvmsolutions.com/pqel/default.asp						(10) Estimated Amount (\$) to be Paid to Subcontractors			
						(11) Estimated Percentage (%) to be Paid to Subcontractors*			

***Divide estimated amount by Bid Value to determine percentage (%)**

Do not enter an estimated amount in the totals for subs with no CPUC or Small Business

2/16/2018

DocuSigned by:

Bill Rethberg

Signature

I hereby certify that the information listed is true to the best of my knowledge.

Date _____

**INSTRUCTIONS**

Complete items numbered 1-11 and submit with your bid proposal.

- (1) Include the complete name of ALL subcontractors Bidder plans to use to support the PG&E contract. Please spell out acronyms.
- (2) Include each subcontractor's **CPUC Clearinghouse** Verification Order Number (VON) as listed in the CPUC Clearinghouse database (if applicable).
- (3) Include each subcontractor's Diverse Code (if applicable). See Diverse Code List below.
- (4) Include each subcontractor's **Small Business** number (if applicable). See Small Business Instructions below.
- (5) Include each subcontractor's Small Business Code (if applicable). See Small Business Code List below.
- (6) Include the city, state and zip of each subcontractor.
- (7) (A) Provide a brief description of the work each subcontractor will be performing. (B) Indicate if the subcontractor will be performing low, medium or high risk work. Refer to PG&E's Contractor Safety Standard (SAFE-3001S): <http://www.pge.com/contractorsafety/> for additional information.
- (8) Include the estimated amount to be paid to each **CPUC Clearinghouse** subcontractor with a VON number.
- (9) Include the estimated amount to be paid each **Small Business** subcontractor with a Small Business number.
- (10) Total the estimated amount to be paid to each **CPUC Clearinghouse** subcontractor with a VON number (column 8), then;
Total the estimated amount to be paid to each **Small Business** subcontractor with a Small Business number (column 9).
- (11) Divide the estimated total amount to be paid to each **CPUC Clearinghouse** subcontractor with a VON number (column 8) by the Bid Value to calculate the percentage, then;
Divide the estimated total amount to be paid to each **Small Business** subcontractor with Small Business number (column 9) by the Bid Value to calculate the percentage.

Do not enter an estimated amount for subcontractors without a CPUC Clearinghouse or Small Business number. Do, however, list the name, diverse code (if applicable), address and work description.

DIVERSE STATUS

To locate the Verification Order Number (VON), diversity status or to find potential subcontractors, access the CPUC Clearinghouse Database: <https://sch.thesupplierclearinghouse.com/FrontEnd/SearchCertifiedDirectory.asp>

Diverse Code List

WBE Women Business Enterprise: A business enterprise that is at least 51 percent owned by a woman or women, or, in the case of any publicly-owned business, at least 51 percent of the stock of which is owned by one or more women, and whose management and daily business operations are controlled by one or more of those individuals

MBE Minority Business Enterprise: A business enterprise that is at least 51 percent owned by a minority group or groups, or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more minority-group individuals, and whose management and daily business operations are controlled by one or more of those individuals.

DVBE The same meaning as defined in subdivision (g) of the Military and Veterans Code and must meet the "Control" criteria. An enterprise which is 51 percent owned by a California Service Disabled , or the stock is 51 percent owned, by one or more disabled veterans, and whose management and daily operations are controlled by one or more of those individuals.

LGBTBE A business enterprise that is at least 51 percent owned by a lesbian, gay, bisexual, transgender person or persons, or, in the case of any publicly-owned business, at least 51 percent of the stock of which is owned by one or more LGBT person and whose management and daily business operations are controlled by one or more of those individuals.

The information provided on this Exhibit may form the basis of a Statement of Record, against which PG&E may conduct an audit or review to ensure compliance.

SMALL BUSINESS STATUS

To determine Small Business status or to find potential subcontractors, access the following sites:

DGS Department of General Services (DGS):
<http://www.dgs.ca.gov/pd/Programs/OSDS.aspx>

SBA Small Business Administration (SBA): <https://www.sba.gov/contracting/getting-started-contractor/qualifying-small-business>

Small Business Code List

SBE-DGS A small business certified by the Department of General Services.

SBE-SBA A small business registered by the Small Business Administration.

SBE-OTH A small business registered by another agency that issues a Small Business number.

NOTE:

Subcontractors may have a **CPUC Clearinghouse** and a **Small Business** certification. Please list both. If a company has more than one Small Business certification, the order of priority in which to list certifications is as follows: (1) Department of General Services (DGS), (2) Small Business Administration (SBA), (3) Any other small business registry where a number is issued.

Table 1
2018 Inundation Mapping DSOD High Hazard

Dam Name	DSOD Dam No.	FERC Proj. No.	DSOD Hazard Classification	FW Report	PMF Report	GEI Prepare:				Due By
						Inundation Maps	CAS FW Report	Inundation Maps	CAS Inundation Maps	
Chili Bar	97-125	2155 High	N	N	N	Y	N	Y	N	
Halsey Afterbay (Christian Valley)	97-015	2310 High	N	N	N	Y	N	Y	N	
Pit 3	97-098	233 High	N	N	N	Y	N	Y	N	
Pit 4	97-100	233 High	N	N	N	Y	N	Y	N	
Pit 5 Diversion	97-107	233 High	Y	N	N	Y	N	Y	N	
Pit 5 Open Conduit	97-108	233 High	N	N	N	Y	N	Y	N	
McCloud	97-123	2106 High	N	N	N	Y	Y	Y	Y	
Iron Canyon	97-124	2106 High	N	N	N	Y	N	Y	N	
Pit 6	97-121	2106 High	N	N	N	Y	N	Y	N	
Pit 7	97-122	2106 High	N	N	N	Y	N	Y	N	
Macumber	97-094	1121 High	N	N	N	Y	N	Y	N	
North Battle Creek	97-096	1121 High	N	N	N	Y	N	Y	N	
Indian Ole (Mountain Meadows)	97-113	N/A	Y	N	N	Y	N	Y	N	
Bucks Diversion (Lower Bucks)	94-000	619 High	N	N	N	Y	N	Y	N	
Grizzly Forebay	94-003	619 High	N	N	N	Y	N	Y	N	
Butt Valley	93-000	2105 High	N	N	N	Y	Y	Y	Y	
Belden Forebay (Caribou Afterbay)	97-120	2105 High	N	N	N	Y	N	Y	N	
De Saba Forebay	97-005	803 High	N	N	N	Y	N	Y	N	
Halsey Forebay No. 1	97-023	2310 High	N	N	N	Y	N	Y	N	
Halsey Forebay No. 2	97-023	2310 High	N	N	N	Y	N	Y	N	
Kidd Lake Auxiliary	97-025	2310 High	N	N	N	Y	N	Y	N	
Kidd Lake Main	97-025	2310 High	N	N	N	Y	N	Y	N	
Scott	97-101	77 High	Y	N	N	Y	N	Y	N	
Lower Bear River	97-115	137 High	N	N	N	Y	Y	Y	Y	
Lake Tabaud	97-067	137 High	N	N	N	Y	Y	Y	Y	
Lyons	97-073	1061 High	Y	Y	Y	Y	N	Y	N	6/30/2018
Relief	97-080	2130 High	Y	Y	Y	Y	N	Y	N	6/30/2018
Main Strawberry (Pinecrest Lake)	97-074	2130 High	Y	Y	Y	Y	N	Y	N	6/30/2018
San Joaquin No. 2 Reservoir (Manzanita Lake)	95-012	1354 High	N	N	N	Y	N	Y	N	
San Joaquin No. 3 Forebay	95-006	1354 High	Y	Y	Y	Y	N	Y	N	
Kerckhoff	95-008	96 High	Y	N	N	Y	N	Y	N	
Balch Afterbay	95-002	175 High	N	N	N	Y	N	Y	N	
Balch Diversion (Black Rock)	95-000	175 High	N	N	N	Y	N	Y	N	
Lake Valley Auxiliary	97-032	2310 High	N	N	N	Y	N	Y	N	
Lake Valley Main	97-032	2310 High	N	N	N	Y	N	Y	N	
Totals			8	3	3	33	4	4	4	

Summary Notes
22 dam breach map sets only
8 dam breach reports and map sets
3 CAS breach reports and map sets; also dam breach map sets
1 CAS breach report and map set
1 location no additional work unless DSOD requests

Total of 8 dam breach reports, 33 dam breach map sets, 4 CAS breach reports, 4 CAS map sets.
Colors note potential bundles by geographic location.

**Re: Engineering Services
2018 DSOD High Hazard Dam/Spillway Inundation Mapping**

GEI Consultants, Inc. to perform engineering services regarding the 2018 DSOD High Hazard Dam/Spillway Inundation Mapping for Pacific Gas and Electric Company (PG&E) at multiple locations in northern and central California. The purpose of the work is to conduct dam/spillway failure analysis and report preparation, prepare inundation maps, and prepare Appendix A text for inclusion with Emergency Action Plans.

Deliverables resulting from this work scope support new or recent inundation map requirements under the California Division of Safety of Dams (DSOD) as well as existing inundation map requirements under the Federal Energy Regulatory Commission (FERC). GEI Consultants work will also include participation in a DSOD workshop in summer of 2018.

Background

The California Department of Water Resources developed proposed emergency regulations for Dams and Critical Appurtenant Structures dated October 2, 2017. "Critical Appurtenant Structures" of CASs are:

"...a man-made barrier or hydraulic control structure that impounds the same reservoir as the dam and is 25 feet or more in height, as measured from the upstream toe to the maximum water storage elevation; impounds a minimum of 5,000 acre-feet of water at full reservoir conditions; or has the potential to inundate downstream life or property, including but not limited to emergency spillways, gated spillways, and saddle dams."

Source: 23 CCR 335 et seq (Inundation Maps) - DRAFT 14.5-FINAL.pdf dated October 2, 2017

The new regulations indicate that technical studies be performed and inundation maps prepared for dams regulated by the State of California, except dams classified by DSOD as low hazard, and for spillways that qualify as critical appurtenant structures.

Scope of Work

This scope of work outlines the tasks to perform failure analysis and report preparation for 8 dams and 4 spillways (CASSs), and prepare inundation maps for 33 dams and 4 CASSs. As part of GEI Consultants work, GEI Consultants will prepare Appendix A for 19 EAPs that will include about 1 to 10 dams per EAP. GEI Consultants will participate in a DSOD Technical Workshop on PG&E's behalf.

Scope of Work Tasks:

1. Dam/Spillway Failure Analysis – 8 dams, 4 spillways (CASSs)

This work scope includes analysis to evaluate the hypothetical failure for the dams and spillways identified in Table 1 (attached). The dam and spillway failure analysis will be based on the U.S. Army Corps of Engineers Hydrologic Engineering Center – River Analysis System (HEC-RAS) software with 1-dimensional modeling to evaluate the hypothetical dam and spillway failure and flood wave routing in general accordance with the Federal Energy Regulatory Commission (FERC) Engineering Chapter 2 Guidelines.

GEI Consultants to update existing models for the following four dams:

- Scott Dam (fair weather only, downstream limit: Pacific Ocean)
- Lyons Dam (fair weather and 1986 PMF, downstream limit: New Melones Dam)
- Relief Dam (fair weather and 1985 PMF, downstream limit: New Melones Dam)
- Main Strawberry Dam (fair weather and 1986 PMF, downstream limit: New Melones Dam)

For these existing models, GEI Consultants will use existing digital elevation model (DEM) data that GEI has on file and drawings provided by PG&E, as applicable and available. The PMFs have been updated for Lyons and Relief Dams, but have not been accepted by FERC. Therefore, GEI Consultants will be updating the models based on the 1985 and 1986 PMFs for those two dams. For projects without existing DEM data GEI Consultants will use readily available data such as the U.S. Geological Survey (USGS) DEM data. Model updates will also be based on FERC comments made in letters from FERC dated October 30, 2015, August 7, 2017 and September 20, 2017. General and specific updates are indicated in 1.a. through 1.h. below. The models will extend to the sunny day downstream limit of previous modeling as noted above. If the updated model results suggest model extension might be warranted GEI Consultants will discuss options for moving forward with PG&E.

For new models GEI Consultants will extend the models to a downstream location where the hypothetical failure no longer appears to pose a risk to life and property damage based on the absence of observed habitable structures in the inundation boundary using readily available imagery, inundation is contained within a downstream reservoir, or inundation is confined within the downstream channel. For planning purposes, GEI Consultants has estimated the downstream reaches will extend to the following reservoirs. GEI to begin work on these models upon receiving authorization from PG&E following DSOD's hazard classification confirmation. GEI will need sufficient time (i.e., more than four months) to develop these new models in order to meet 2018 inundation map schedules.

Dam	Dam Height (ft)	Reservoir Storage (ac-ft)	Estimated downstream reach (mi)	Downstream Reservoir (model extent)
Indian Ole (Mountain Meadows)	25	24,800	5	Lake Almanor (1,140,000 ac-ft storage)
Kerckhoff	106	3,100	25	Millerton Lake (520,500 ac-ft storage)
Pit 5 Diversion	58	112	53	Lake Shasta (4,552,000 ac-ft storage)
San Joaquin No. 3 Forebay	40	20	20	Millerton Lake (520,500 ac-ft storage)

New model development and model updates to include the following:

- a. **Manning's n-value** – Manning's n-values will be input based on Jarrett's equation and justification will be provided in the report.
- b. **Breach Parameters** – GEI Consultants to use existing breach parameters for existing models. For new models, GEI Consultants will work with PG&E to develop breach parameters (breach width, breach shape, and time to failure) based on the FERC Chapter II guidelines and the DSOD regulations dated 10/19/2017.
- c. **Bridges** – Work will include a check of the downstream reaches for the presence of bridges using readily available aerial imagery such as Google Earth. For bridges where the low chord is estimated to be inundated, GEI Consultants will model the bridges as cross sections with "lids" using available imagery and the DEM to estimate bridge characteristics.
- d. **Sensitivity Analysis** – GEI Consultants to perform sensitivity analysis to understand how the minimum and maximum breach parameters, time to failure, and n-values effect the peak water surface elevations, incremental rise, and warning times.
- e. **USGS Gages** - For models on river systems with USGS gage data, GEI Consultants will compare the model results with the observed gage data.
- f. **Lyons Dam** – Breach side slopes and width will be reviewed relative to the FERC letter dated October 30, 2015 and either justified or updated. The incremental impact to South Fork Road Bridge (Route 4N01), the Italian Bar Road Bridge (Route 4N26), the Italian Bar Mining Camp, the Parrots Ferry Road Crossing and the Route 49 Crossing will be discussed in the report. GEI's work will not include justification of the Sudden Failure Assessment (item 2 in the FERC letter for Lyons Dam).
- g. **Relief Dam** – After GEI Consultants receives information from PG&E on Donnell's and Beardsley Dams, the PMF analysis will be performed with the initial water surface elevation for these two dams set at the normal maximum pool levels as discussed in the FERC letter dated October 30, 2015. Model updates for Relief Dam will also include a review and revision as appropriate of the downstream concurrent PMF flows, spillway elevations for Donnell's and Beardsley Dams, breach width for Beardsley Dam, initial water surface elevation for New Melones Lake, and a review with PG&E of the downstream limit of the model. The crest elevation of New Melones Dam will be included in the update to the Sunny Day breach report. Roads, buildings, and recreational areas will be noted on the Relief Dam inundation maps consistent with PG&E 2017 formatting. GEI's work will not include justification of the Sudden Failure Assessment (item 10 in the FERC letter for Relief Dam).

- h. **Main Strawberry Dam** – Update for this dam will include a review of the average breach width relative to the FERC comments in the letter dated October 30, 2015. GEI's work will not include justification of the Sudden Failure Assessment (item 2 in the FERC letter for Main Strawberry Dam).

2. Dam/Spillway Failure Reports

For the 8 dams and 4 spillways (CASSs), GEI Consultants will summarize the hypothetical failure analysis, methods, and results in a summary report for each of the 12 dams/spillways. GEI Consultants will submit the draft reports to PG&E for review prior to preparing final reports. GEI Consultants to include preparation of six hard copies of the final reports and inundation maps. The reports will include compact disks containing the electronic HEC-RAS files, GIS inundation map files, and report. GEI Consultants will also transmit digital copies of reports, HEC- RAS files, GIS inundation map files to PG&E via Sharefile.

3. Inundation maps – 33 dams, 4 spillways (CASSs)

GEI Consultants will use inundation boundaries from existing and new modeling to prepare inundation maps. The inundation maps will be prepared in general accordance with the FERC Chapter 6 guidelines, and will be based on the ERM 2015 format. Hard copies of the maps will be included in the dam/spillway failure reports. For dams that will not have 2018 reports prepared, GEI Consultants will provide six hard copies of the maps. GEI Consultants will also transmit digital copies of inundation map pdfs and GIS inundation map files to PG&E via Sharefile.

4. Appendix A

GEI Consultants will prepare Emergency Action Plan Appendix A, Summary of Investigation and Analyses of Dam Break Floods summary documentation for 19 emergency actions plans each of which will include about 1 to 10 dams. GEI will provide this information to PG&E electronically via email or Sharefile.

5. DSOD Workshop

Per PG&E request, GEI to participate in a one-day DSOD Technical Workshop on PG&E's behalf. The workshop is expected to occur during summer 2018. This work scope includes time for Lissa Robinson to attend this workshop. As part of this scope, GEI will only charge travel from their Oakland office to the DSOD meeting and will not charge out of state travel or hotel for this task.

Table 1 attached is a summary for the 2018 Inundation Mapping of DSOD High Hazard Dams. Table 2 provides a summary of tasks and GEI's cost estimate to perform the work.

Assumptions

1. GEI Consultants work scope assumes that PG&E will provide updated documents (i.e., most recent STIDs and spillway assessment reports) and drawings of the spillways and dams showing details including downstream channel and the dam/spillway foundation to guide the selection of model geometry and breach parameters in the development of new analysis.

2. PG&E will provide digital shapefiles of inundation boundaries for fair weather and PMF cases for older studies where GEI provided the HEC-RAS models to PG&E and PG&E created inundation boundaries. This includes the following dams:
 - Bucks Diversion (Lower Bucks)
 - Grizzly Forebay
 - Butt Valley
 - Belden Forebay (Caribou Afterbay)
 - San Joaquin No. 2 Reservoir (Manzanita Lake)
 - Balch Afterbay
 - Balch Diversion (Black Rock)
3. GEI Consultants assumes there will be no inundation of flat terrain, and therefore that 2-dimensional modeling will not be required. If GEI Consultants finds 2-dimensional modeling is warranted GEI Consultants to work with PG&E to discuss options for moving forward including the possible need to amend the scope.
4. In the event existing models do not run on the newer HEC-RAS software or GEI Consultants encounter other issues with the existing models GEI Consultants will discuss options with PG&E for moving forward especially if GEI Consultants encounter issues with older model inputs and performance.
5. The DSOD Technical Workshop is anticipated to occur on one day in 2018.
6. PG&E to provide information regarding Donnell's, Beardsley, and New Melones Dams to help guide GEI in addressing questions in the FERC letters dated October 30, 2015 relative to these downstream dams.

Scope does not include site visits, field surveys, population estimates within the inundation boundaries, property damage estimates, future development forecasting, or preparation or updating of Emergency Action Plans. GEI Consultants scope of work is complete upon submittal of the revised maps in pdf format as well as CDs of the GIS data to PG&E. GEI Consultants will develop a proposal for additional tasks or follow-up work as requested by PG&E. GEI Consultants assume that PG&E will submit map information and files to FERC and DSOD as applicable.

Project Team

The key personnel for this project have been chosen based on their experience and successful performance on recent PG&E projects. Lissa Robinson will be the Project Manager and Lead Engineer responsible for the work. Merritt Hall, Leila Pike, Nick Miller, Alex Gray, Jessica Mason, and Brenda Pinkham will assist with models, inundation map preparation, and report preparation. Brenda Pinkham will also assist with transmitting the digital maps and GIS data to PG&E. Mark Fortner and Chris Ferrari will assist with quality assurance/quality control as in-house reviewers. Bill Rettberg will serve as the Senior Consultant, and will sign and seal the maps and reports.

Estimated Budget

Estimated budget to complete the scope of work described above is \$872,300 based on the hours and rates tabulated in Table 2, attached. Budget is based on 2018 rates, which is an increase of approximately 5% from the 2016-2017 MSA fee schedule. GEI Consultants understand that PG&E has established an initial budget amount as a subset of the overall project budget and may issue additional budget allocations as the project progresses. GEI Consultants will not exceed the overall estimated project budget amount issued in the CWA (Contract Work Authorization) or interim budget allocations without written authorization from PG&E.

It is important for work to begin as soon as possible for PG&E to meet regulatory schedules. GEI Consultants to provide draft reports and maps to PG&E to review upon completion of each individual dam/spillway. GEI Consultants needs to be aware of the schedule for PG&E to submit the Lyons, Relief, and Main Strawberry Dam updated report and inundation mapping by June 30, 2018 and should begin work on those dams first and as directed by Project Engineer Andrew Fisher. GEI Consultants should also be aware of the schedule for PG&E to provide EAP updates to DSOD by January 1, 2019 and that those EAPs should include inundation maps previously submitted and approved by DSOD.

GEI to perform the work outlined in this proposal in accordance with the Master Service Agreement No. 4400006370 between GEI and PG&E dated February 8, 2012 and valid through March 31, 2018.